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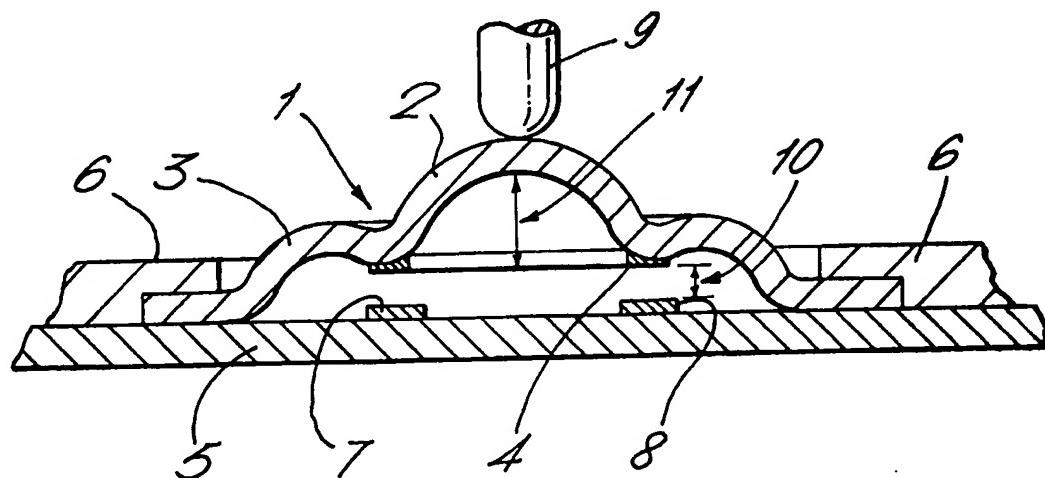
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degree of pre-travel before contact  
is made, and provides for overtravel  
after contact is made.

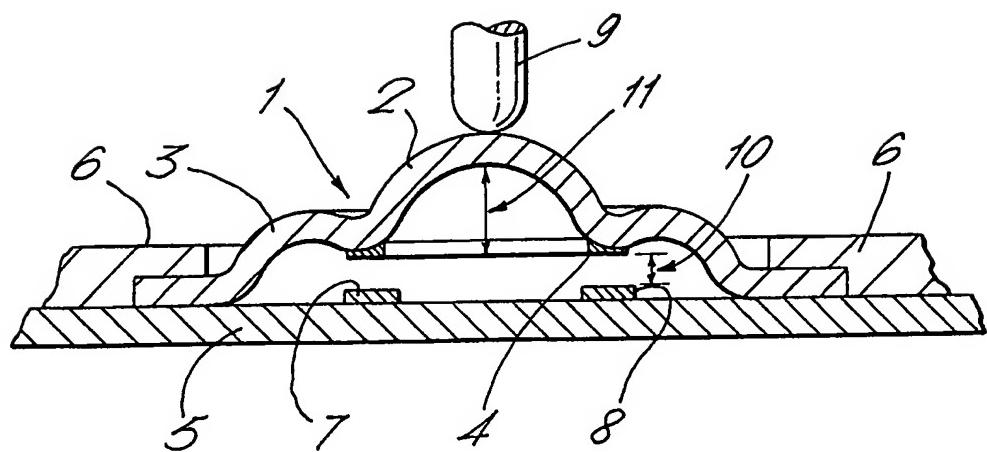
## (54) Double-domed conductive disc

(57) In a push-button operated switch of the snap dome type, the movable element is a double-dome disc (1) having its inner dome (2) stiffer than its outer dome (3), with the movable contact formed by a conductive annulus (4) at the intersection of the two domes, whereby, force applied to the crest of the inner dome (2), e.g. by a plunger (9) moved by push-button operation causes collapse of the outer dome (3) so that the annular contact (4) bridges the stationary contacts (7, 8), followed by collapse of the inner dome (2). The arrangement gives a



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## SPECIFICATION

### Double-domed conductive disc

- 5 This invention relates to electrical switches of the push-button or plunger actuated type, and especially to such switches using movable members of domed form.

Switches of the above type are well-known, 10 and with suitable choice of material, e.g. silicone rubber, have been shown to have excellent life (e.g. 100 million operations), with switch deflections of up to 4 mm. However, such "dome-type" switches as hitherto used have certain drawbacks. Thus in the 15 basic switch type referred to there is no overtravel since the simple moulding does not provide overtravel unless some additional feature such as a spring associated with the switch actuator. Further as the contact is simple it may only provide a single point contact the reliability of which may be somewhat limited.

An object of the invention is to provide a 25 switch of the above type in which the disadvantages of known types of switch are minimised or even overcome.

According to the invention there is provided 30 an electrical switch which includes a double-domed disc of a resilient insulating material mounted on an insulating material substrate, the two domes being concentrically and contiguously arranged with the inner dome being stiffer than the outer dome in which the disc 35 has an electrically conductive region at the intersection of the two domes and aligned with electrical contact areas on the substrate, and in which the switch is operated by pressure applied to the crest of the inner dome, 40 which pressure causes collapse of the outer dome followed by collapse of the inner dome during which collapse sequence the conductive region on the double domed disc engages and electrically interconnects the contact areas 45 on the substrate.

An embodiment of the invention will now be described with reference to the accompanying drawing, which is a cross-section of a switch embodying the invention.

50 The moving member of the switch is a disc 1 of an electrically insulating and resilient material such as rubber or synthetic rubber which has a central dome 2 surrounded by an annular outer dome 3. On the underside at 55 the intersection of the surfaces of the two domes there is an annular contact 4 formed by a conductive washer moulded into the disc.

In its simplest form the annular contact can 60 be of a conductive elastomer, e.g. conductive silicone rubber, but conductive metallic washers can be used, either as solid washers or as spiral springs formed into washer shape. The spring spirals in the latter case are securely 65 moulded into the elastomer disc body with

only the lower part of the spirals of the spring exposed to engage with stationary contacts. Thus the spirals provide multi-point contacts of low resistance.

70 The contact 4 is made from metallic conductive annuli when low contact resistance is needed. In many cases, however, e.g. when switching MOS integrated circuits, the increased contact resistance due to conductive 75 elastomer can be tolerated. Such resistance is in the range of 50 ohm to 1000 ohms.

The double domed disc 1 is mounted to a substrate 5 of an insulating material by the retainers shown at 6. The substrate 5 causes 80 electrical conductors 7, 8 between which connection is effected on operation of the switch.

To operate the switch a push-button (not shown) is depressed, which causes an actuating plunger 9 to apply a force to the crest of 85 the inner dome 2 of the disc. This inner dome is stiffer than the outer dome 1, so the outer dome collapses, moving the annular contact 4 down until it engages and bridges the conductors 7, 8. These conductors 7 and 8 form part 90 of two sets of interleaved fingers one set for each fixed contact, and when the annular contact 4 bridges them it produces a number of parallel contacts.

The pre-travel before contact is made is 95 given by the dimension 10, and when contact is made, the applied force causes the inner dome 2 to collapse to give an overtravel beyond the point of contact equal to dimension 11 shown. Such overtravel gives a good 100 contact pressure and facilitates the switch returning to its rest position on release.

The forces needed to collapse the domes can be controlled by varying the thickness of the dome material, so that any desired force- 105 deflection characteristic can be achieved over the travel.

Air trapped in the dome must be allowed to escape during operation to avoid impairment of the deflection characteristic: in the present 110 arrangement this is achieved by the leak past the printed circuit conductors 7, 8 as they pass under the rim of the disc. If this is not adequate holes could be provided in the disc or the substrate.

115 Such double domed disc can be used in individual switch modules or in keyboards. In the latter case the domes are moulded into continuous strips or rectangles and cut to the sizes appropriate for the keyboard. In such 120 cases the substrates are fairly large printed circuit boards, most economically provided by conductive epoxy printing. Modular keys use contacts (7 and 8) moulded in tags or rivets.

### 125 CLAIMS

1. An electrical switch which includes a double-domed disc of a resilient insulating material mounted on an insulating material substrate, the two domes being concentrically and contiguously arranged with the inner dome being stiffer than the outer dome in which the disc has an electrically conductive region at the intersection of the two domes and aligned with electrical contact areas on the substrate, and in which the switch is operated by pressure applied to the crest of the inner dome, which pressure causes collapse of the outer dome followed by collapse of the inner dome during which collapse sequence the conductive region on the double domed disc engages and electrically interconnects the contact areas on the substrate.

- dome being stiffer than the outer dome, in which the disc has an electrically conductive region at the intersection of the two domes and aligned with electrical contact areas on the substrate, and in which the switch is operated by pressure applied to the crest of the inner dome, which pressure causes collapse of the outer dome followed by collapse of the inner dome during which collapse sequence the conductive region on the double domed disc engages and electrically interconnects the contact areas on the substrate.
5. A switch as claimed in claim 1, and in which the conductive region is a metallic annulus moulded into the disc material at said intersection.
6. A switch as claimed in claim 2, and in which the annulus is a plain metallic washer.
7. A switch as claimed in claim 2, and in which the annulus is a spiral spring moulded into the disc material.
8. A switch as claimed in claim 1, and in which the disc material is a non-conductive rubber or rubber-like material and the conductive region is an annulus of an electrically conductive elastomer.
9. A multiple switch assembly using a number of switches each as claimed in any one of claims 1 to 5, and in which the double-domed discs are made in bulk in strips or rectangles from which the discs needed are cut.
10. An electrical switch substantially as described with reference to the accompanying drawing.

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